《論　文》

Mobile Phone Technology Integration into Open Source LMS for University General Education Classes in Japan

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Abstract

The aims of this research project were to develop mobile phone activities to enhance classroom-based teaching. Our strategy was to create three different kinds of programs for students:

1) Mobile phone language study via email to learn vocabulary on specific content.
2) Mobile phone lecture feedback to collect questions and summarize lecture content.
3) Mobile phone attendance-taking to streamline class administration.

The first aim was accomplished by three teachers testing an email-based vocabulary study system in their classes. A database of words, definitions, and translations was created. Then a PHP script was developed to pull words from the database according to a template designed by a teacher. The prototype program was successful and students reported few problems with the messages, except those with very old phone handsets. However, the primary issue is the time required for teachers to set up the templates and the lack of direct feedback to teachers from students compared to a face-to-face classroom situation. Unless the databases for quizzes and the email study can be integrated, it is unlikely that teachers would take the time to build up a library of scripts. The second and third aims showed more progress and use by students and teachers has continued. In previous research projects, our group developed an e-learning module to automate the lecture feedback papers returned to teachers at the end of classes. The student input was done on computers after the class had finished. In this phase of research, we developed a mobile phone input system so that students would be able to complete the attendance operation and submit a summary of the lecture within the class time. In effect, we created a real-time feedback system that saved time and trouble for both students and teachers. This lecture feedback and attendance slip system still has a small number of students who are unable to connect through their specific phones. This problem and other interface design issues need to be investigated with interviews and other follow-up research. Finally, the implication of this research is that mobile phones will play a key role in e-learning systems and in many aspects of course management.

Keywords: e-learning, mobile phones, open-source, CALL, foreign language education, learning management systems, Moodle

1 Introduction

Technology has been viewed with fascination by educators seeking to improve the processes of instruction. Audiotapes, television, videos and computers have all been applied to the foreign language classroom. Each technology subsequently loses its appeal as another technology takes its place — a wasteful exercise claimed by critics of educational technology (Cuban, 2001). The teachers in this study initially took the same approach as their predecessors by adopting an appealing new technology — mobile phones — and introducing activities using this tool into their classes. By investigating the role of the mobile phone in university EFL courses in Japan, and by evaluating its success or failure, we hope to understand the process of designing a blended learning environment and observe how innovation in education happens. We can then draw conclusions about the future of mobile devices in e-learning.

E-learning emerged from Computer Based Training (CBT), a discipline born in the 1970s and dedicated to explore the possibilities of ICT (Information and Communication Technologies) in the field of training methods and techniques. One example of CBT was vocabulary and grammar training programs such as BBC CALL laboratory software, where students took a packaged program on a CD or in a computer lab and answered numerous drill questions. CBT developed slowly for two decades and its use was reserved only for educators with a background in advanced technology. Gradually, CBT evolved from simulation software and multimedia CDs to web technology, creating spaces to integrate the school campus with cyberspace. These virtual campuses are called learning management systems (LMS), course management systems (CMS) or simply "e-learning". Thus, CBT became out-moded along with other forms of single-computer, programmed instruction.

Paralleling the social adoption of web technologies, e-learning programs have largely become a requirement at educational institutions. Teachers and students found in e-learning a place to develop learning strategies. As mobile communication devices have proliferated and have been increasingly applied to classroom learning, a new kind of e-learning emerged, referred to as "m-learning" by Quinn (2001) and Nyiri (2002). Thus, the cutting edge of information technology has moved from CBT to e-learning and could now turn to a focus on m-learning.

2 Mobile Learning

This potential new development for teachers and learners has attracted the attention of educators and researchers, including Sharples (2000, 2005), Sharma & Kitchens (2004) and Alexander

(2004). DiGiano, Yarnall, Patton, Roschelle, Tatar, & Manley (2003) recommends a framework for planning a "wireless classroom" which involves a variety of mobile devices including wireless notebooks, PDAs, servers and mobile phones. Experiments with mobile phone language learning applications in Japan have been conducted over the past five years by Thornton & Houser (2005). Their research confirms that students show a great interest in using mobile phones as learning devices. They also found that Japanese students demonstrated high levels of manual dexterity in inputting characters into handset buttons. Surprisingly, young Japanese could input sentences into mobile phones at rates approaching 70% of the average speed of two-handed keyboard entry into standard computers (Houser & Thorton, 2004).

Not surprisingly, younger students seem to have an advantage in this field due to their extensive use of mobile phones. While many teachers have embraced the culture of email and web publishing, younger students have out-paced their teachers with savvy use of instant messaging tools, SMS, mobile phones, game pads, iPods and other electronic gear that they carry with them constantly. Mobile devices provide ubiquitous access and new kinds of user interaction, such as integrated voice streaming, digital cameras and positioning systems. However, they also have significant limitations in terms of screen size, cost and speed of network traffic, batteries and wide and incompatible range of client devices. Wang and Higgins (2006) discuss a number of major limitations in mobile learning technology. These are summarized in Table 1.

Table 1: Limitations to Mobile Phone Learning

Category	Limitation
Psychological	1. Slow change in habits 2. Suspicion of health risks
Pedagogical	3. Difficult to follow up learning achievements, lack of always-on connectivity to internet. 4. Testing not possible, unable to authenticate actual learner 5. Lack of classroom atmosphere in distance learning, high drop-out rate, lack of firm framework encourages laziness 6. Surrounding environmental interruptions
Technical	7. Small screen and low resolutions 8. Input limitations 9. Distorted web pages 10. Lack of standardization and compatibility 11. Small memory and storage

In addition to the above list, there are other technical problems concerning portability of code for the development of mobile phone learning applications. Without a standard interoperable code, each teacher or each school must reinvent the applications. Thorton & Houser (2005) used

custom coding based on the Perl scripting, a language which did not integrate with standard learning management systems. Forcing teachers to learn programming would not allow replication of these promising experiments. By joining a collaborative development community which uses a portable, modular and standardized code, the mobile learning applications have a chance to be adopted by other schools.

Another significant pedagogical issue with mobile phone learning is the generic, stand-alone content often produced for use on mobile phones. Singh (2003) argues for a "context-driven, task-sensitive, performance-support model of mobile learning". These principles underlie project-based learning programs which propose that learning is best organized around an important task. Thus, a mobile phone support system might provide vocabulary and grammar training designed to reinforce and enhance a particular project, rather than simply serving as a proficiency-based word list based on universal word difficulty levels, such as those developed for TOEIC or JACET tests. Chen, Kao, Sheu, & Chang, (2002) support similar principles, recommending that the pedagogical design of mobile learning consider the urgency of learning need, the degree of interactivity within learning process, and whether the application is situated or integrated with other instructional activities.

McLean (2003) reminds us of the constant problem of most educational technology initiatives:

> *...with technology "pushes", there is far too little attention being paid to social processes and emergent behaviour of learning communities who adapt to new technologies, such as the mobile phone." (p. 13)*

The principle of a 'learning community' for most students means the classroom and the online website provided by the learning management system. When the development of mobile phone applications is isolated from this community, it de-contextualizes the learning environment. On the other hand, when mobile learning applications and content reinforce the learning in classrooms or on a main website, the learning will be related and bonded to the web-based software that educators and learners are already using. Much of e-learning is now focused on learning management systems as interactive websites to manage education. M-learning must not replace these e-learning techniques but complement them. Thus, a successful approach will need to enable an LMS to reach and interact with mobile devices. This will be described in section four, "Learning Management Systems".

3 Mobile Phones and Language Learning

The function of mobile phones and language learning is a dynamic and fluid area of research. The following summary of references will give some idea of the types of work being done and the potential for future developments.

Pemberton, Fallahkhair, and Masthoff (2005) used cell phones in conjunction with interactive television (iTV) to promote language learning. While iTV offered various forms of interactivity such as subtitles, background information and chats, many users found this to be too fast to use concurrently while watching the program in a social setting. Many of the same options of interactivity and supplemental information were made available on cell phones giving students more control for personalizing the supplemental information to their individual needs. Pemberton et. al. are continuing the research on this dual device approach to learning.

Quasha (2003) began using the cell phone in his non-CALL class because students were constantly using them for personal reasons (i. e. as a disruptive technology) and his attempts to prevent students from using them were in vain. Exploiting the fact that the vast majority of modern cell phones in Japan come with a digital camera, he followed the old adage, "if you can't beat them, join them" and looked for ways to incorporate the phones into lessons. In his class, students were required to use their cell phones to create a photo journal which was used as a springboard for starting conversations with other students. This use of a mobile device allowed students to truly personalize their English and a survey at the end of the semester found that students reacted positively to this.

Although not concerned directly with language learning, the insights provided by Ratto, Shapiro, Truong and Griswold (2003) shed considerable light on the use of mobile devices in this field. Concerned with the recent trend of decreased participation in the classroom, Ratto et al (2003) developed an application known as ActiveClass designed to work with PDAs and mobile phones to increase communication in the classroom. Features of this application include the ability of students to anonymously ask teachers questions, participate in polls, and provide feedback on classes. Additionally, students may see questions posted by other students and vote on them thereby letting the teacher know how many students wish the question to be answered. By observing two large lecture classes (125 and 150 students) taught by two different teachers that met four times a week for 10-weeks, an examination of the effects of ActiveClass was made. The authors found viewing the classroom as an ecology beneficial in understanding the various dynamics between the students and teacher. Of pertinence, the researchers found the following benefits: a) teachers could use the list of question provided electronically by students as an aid

for remembering after class what areas needed clarification and could prepare for the following class, b) the anonymity of the system helped students feel free to ask questions, c) the voting system helped filter out questions that could waste valuable class time and d) the teachers reported a higher level of questions being asked with ActiveClass in place compared to previous semesters without it. A few negatives said about the system included a) the small screen made it difficult to vote on or write questions, b) it was difficult to add a mobile device to an already cramped desk space and c) occasional technical glitches.

Ring (2001) reports on a study on the use of mobile phones to supplement content found on the WWW. Prior to the course, the majority of the students reported that they did not plan to use the mobile phone feature due to the small screen size. However, after trying it many found the phone to be a valuable asset to their studies due to the convenience of being able to study anytime anywhere. In particular, the coach feature that reminded students of important deadlines and the multiple-choice quizzes with immediate feedback were regarded highly by students. Ring noted the importance of having a system of easy navigation on cell phone screens.

Thorton and Houser's 2005 work presents three projects they conducted on the use of cell phones in mobile learning. The first examined cell phone use of 333 Japanese university students. One hundred percent reported owning a cell phone with 99% having sent an email and the average student sending 200 email messages each week. Only 43% of these same students reported having ever sent an email by PC with an average of 2 per week.

In their second project, they 'pushed' English emails to students' cell phones 3 times a day to encourage frequent study. This concept was based on studies in cognitive psychology that found that if two presentations of a stimulus are close together, it will only remain in memory for a relatively short time span. However, if two presentations of a learning object are spanned a short distance apart, the time it remains in memory is dramatically increased. As cell phones in Japan have been a ubiquitous part of society, their use for presenting multiple, spanned presentations of a learning object was deemed ideal. Compared to students who were encouraged to study every day, students who received the 'pushed' emails scored considerably higher on quizzes. The vast majority of the students considered the 'pushed' emails to be a 'valuable teaching method.' These findings are consistent with a wide body of research (Johnson, 2005) that shows that both the number of exposures to new vocabulary and the interval frequency that students have to it can be closely correlated to the effectiveness with which the new words was retained. Nation, (1990) stated anywhere between five and sixteen exposures are needed for long term retention.

In Thorton and Houser's third project, students made short movies to explain idioms which

were viewable on video-capable phones. Students found the videos a valuable study aid. The main drawback for the videos concerned the audio which was difficult to hear or felt to disturb neighbors.

Of note, Thorton and Houser (2005) report that cell phone use is better suited toward review of material rather than for learning new content.

Discussing the current shift in thinking on how mobile devices can be used effectively to further education, Upadhyay (2006) presents three main advantages. One, students gain the 'freedom, power and choice' to study what, when and how they study. Two, administrative functions allow students to stay efficiently organized with mobile devices thereby maximizing their learning experience. Three, students have the flexibility to study where they wish and allow for 'just-in-time' access when and where information is needed.

Finally, Chinnery (2006) provides a concise summary of much of the current research on mobile learning with sections devoted to research on cell phones, personal digital assistants (PDAs), and iPods. This is recommended reading for those interested in a crash course on the current state of mobile learning research.

4 Learning Management Systems

Learning management systems are online environments which collect and administer various learning activities both online and offline. Fundamentally, they are a single server-side database with scripts that provide interactivity and communication amongst members. These LMSs emerged in the 1990s along with the proliferation of broadband internet to provide 24-hour access of learning activities and resources for students. Initially, LMSs were in-house proprietary packages built by universities for their own use. Later, commercial (WebCT, Blackboard) and open source (Claroline, Moodle) packages became available.

4.1 Open vs. Proprietary Learning Management Systems

While hundreds of home-grown LMSs were developed by university departments and research institutes, the first popular, commercial one was WebCT, licensed by the University of British Columbia. This was followed by Blackboard and numerous other smaller, niche LMSs for corporate training and public school applications. In 2000, the first publicly released open source LMS, Claroline, was offered by the University of Luevin, Belgium. Later, Moodle, Atutor, Dekeos, SiteSchool and other open source scripts followed.

4.2 Moodle as an Open Source Learning Management System

By 2006, Moodle had captured the second largest market share of all commercial and open source LMSs. It has the potential to dominate the future of LMS development due to the energy of its user/developer community and commitment by major institutions. One example of this happened in 2005 when the largest university in the world, the Open University of the UK (150,000 students), began moving its vast LMS operations into Moodle and committed a staff of ten engineers to full-time work transferring, developing, and maintaining the system. In addition, the Moodle LMS has aggressively attempted to integrate international e-learning standards for portability of content and methodology (Berggren et al, 2005).

Currently, Moodle is the most popular open source LMS with more than 16 million users around the world. It is supported by a large virtual community of teachers, researchers and developers with more than 360,000 registered members (Moodle, 2008a). Much of Moodle is designed with a bias toward social constructionist pedagogy which argues that learning is particularly effective when the student is part of a social group. This approach has turned Moodle in a framework for combining e-learning and social collaboration activities. In the largest use-case, Moodle LMS itself powers the main community site, http://moodle.org. The open source and modular nature of Moodle allows developers to modify existing code, develop new features and contribute them to the community. This study describes present and future developments and experiences of mobile, m-learning tools developed using Moodle as a starting point.

5 Research Design: Collaborative Development of LMS-Mobile Phone Integration

One of the earliest mobile device integrations into the Moodle LMS was the podcasting module built by a third party in 2005 to handle single audio files or “podcasts”. This add-on activity module is an optional module that can be downloaded and easily installed into a Moodle LMS server installation. This demonstrates the possibilities of community-built alternatives that are possible with an open source development structure. Another extensive project is documented with the Moodle for Mobiles Project (Moodle, 2008b) which focuses on interactive activities using mobile phones.

5.1 Moodle for Mobiles Project

This collaborative mobile phone-LMS integration effort began in 2005, where four universities in Japan coordinated funding of mobile phone module development for the Moodle LMS.

Teachers and teacher/programmers from these universities had independently begun development of multiple modules and modifications of the standard Moodle system. These were their projects:

- Kanazawa Gakuin University: iMoodle project — modification of the original Moodle code to reframe standard screen size down to mobile phone size (especially in: quiz, resource, hotpot).
- Hokusei Gakuen University: mobile phone email address input field in profile page of Moodle, quick mail block adaptation for sending mass email to student mobile phones, mistyped mobile phone address reconfirmation process.
- Yamaguchi University: parallel scripting system especially implemented for Japan mobile phones (for quiz scripts, login page, course pages).
- Sapporo Gakuin University: New activity modules such as lecture feedback system and attendance slip logging for large lecture classes.

A major issue was the plethora of competing mobile phone services, web implementations, character encodings, fee structures, and handset hardware differences. For example, some not-so-old handsets had text input without word-wrapping. Others would only handle Japanese in Shift-JIS encoding format, while ignoring the EUC-JP format used internationally and in Moodle. Accommodating such differences required a switch to UTF-8 encoding for all mobile phone text handling, as well as to cHTML as a fairly common coding standard that has been able to accommodate most mobile phone browsers for the last two years. Additionally, a more difficult issue was the Moodle LMS core operation, which used sessions based on cookies, which would be impossible to manage on mobile phones.

To handle these common problems and to coordinate efforts between the above institutions, a series of workshops was held for teachers, programmers and developers whose goal was to establish some common collaborative goals. Following initial presentations (which included the lead programmer who contributed via skype telephony from India), a requirements and strategy workshop was held. In this workshop, current projects, basic requirements, development strategy, needs/applications, priorities and funding and a timeline were mapped out. With programmers, teachers, and funders all contributing in the same room, key decisions were made that could bring a number of applications to fruition in the following six months.

5.2 Software Requirements and Programming Strategies

The basic requirements and development strategy focused on a parallel scripting strategy (for Moodle versions 1.5, 1.6, 1.7), rather than a single script strategy that directly modified current

Moodle module scripts. A single-script strategy would have had to implement a filtering process for taking standard full-size screens displays and adjusting the screen sizes accordingly for mobile phone display. In addition, a limited number of modules and functions for mobile phones were selected (e. g. administration functions were kept in the main PC screen-based interface) and the following roadmap decisions were made:

- target for Moodle versions 1.6 and 2.0 (quiz for version 1.5)
- focus on one country now (Japan), later our work may be replicated in other countries
- change to smarty templates for version 2.0
- build parallel script code based on cookie-less sessions
- deal with Shift-JIS encoding problems by output buffering to UTF8
- focus on a unique mobile phone-human interface rather than modifying a PC screen based interface
- solve core mail problems in Moodle (now based on single byte character sets), avoid the multiple patches currently required for Japanese operation.
- move completely to UTF8 in the core mail system.
- develop a direct mobile email reply-to-forum/assignment system (not via web browser)

5.3 Web-based, Pull Communication

The first developer workshop focused mainly on applications that are web-based "pull" communication tools (i. e. a student goes to the activity location and selects it) communication tools. Five priority applications were agreed on and responsibilities assigned: these were Quiz Module (YU), Hot Potatoes Module (KGU), Mobile Phone Quickmail Integration (HGU), Attendance Slip (SGU), and Lecture Feedback (SGU). Results were initially reported in the moodle.org general developer forum (Moodle, 2005). Table 2 summarizes decisions that were made regarding

Table 2: Application Development Priorities, Funding, and Schedule

Mobile Phone Application	Funding University	Priority & Schedule
1. Quickmail	Hokusei Gakuen University	A－March 2005
2. Quiz	Yamaguchi University	A－November 2005
3. Hot Potatoes (pure HTML)	Kanazawa Gakuin University	A－December 2005
4. Attendance Slip	Sapporo Gakuin University	A－March 2006
5. Lecture Feedback	Sapporo Gakuin University	A－March 2006
6. Polling	Sapporo Gakuin University	B－March 2006
7. Forum	Hokusei Gakuin University	B－March 2006
8. Static Images	Undecided	C－Undecided
9. Flash Lite Interface	Undecided	C－Undecided

applications, funding responsibilities, schedule and priorities.

From this meeting, the research team from Sapporo Gakuin University began or continued work on three web-based applications: 1) Attendance Slip, 2) Lecture Feedback, and 3) Quiz and 4) Polling (based on the third party Feedback module — not to be confused with the Lecture Feedback module). The following sections describe the functions of these modules.

5.3.1 Lecture Feedback Module

Providing feedback for the lectures and registration of attendance codes were, in our previous project, integrated into a single Moodle activity with the old version of Lecture Feedback Module. This module was a direct clone of the paper-based lecture feedback method which is popular in Sapporo Gakuin University (Tanaka, 1999; Matsuda & Sato, 2004) and was found to be useful both for students and teachers (Hinkelman, Okuda & Kudo, 2005). In the present project the previous module was migrated into mobile phones in order to provide students with diverse means of access to Moodle, even from inside the classrooms. The module was also divided into two independent modules to clarify the target of each module and to reduce the connection fee for the mobile web services. For simpler navigation and for a smaller fee, a mobile user interface which shows only the present week's activities has been designed. The standard version and the mobile version of the Lecture Feedback Module are coded to share the same table of the Moodle database. Students are then able to switch from one version to the other while editing their feedback.

The Lecture Feedback Module is based on an internal university system at SGU where teachers have students write questions or summaries at the end of a large lecture-style class. This module was developed to semi-automate the procedure by having students enter their writing into an activity on a Moodle course site. The activity was a modified Journal module which allowed categorization of the student responses. After categorization, a teacher could build a handout of student comments and questions in about half the time it would take doing manually. The problem with this procedure on computer over the former procedure done on paper is that the students could no longer do the feedback in class, but in another period, had to go to a computer room to enter the data. By moving this procedure to mobile, students could do the feedback within the class period and inside the same classroom where the lecture was given.

5.3.2 Attendance Slip Module

To streamline the process of taking attendance of a lecture class session, an embedded function for attendance taking was developed in 2003 as part of the Lecture Feedback Module.

Originally, only a computer-based module, this function was separated and transferred to mobile phone input in 2005. This module was used by students in the same class period as they used the Lecture Feedback Module. In this way students were able to verify their attendance and submit their summary and questions to the instructor without going to a separate computer laboratory outside of the class period.

In many Japanese university institutions, attendance slips are used as small paper slips that students fill out and hand in to the teacher. Collating and marking these slips was very time-consuming and even costly because extra staff had to be hired to manage the slips for large lecture classes. It was also easy for students to defeat the system by handing in extra slips for their absent friends. In this LMS-integrated system, attendance slips are also printed on paper with unique attendance codes marked upon them. When slips are distributed during the class, students can immediately access to the designated Attendance Slip Module via their mobile phones to register the codes into the Moodle database. This activity has now become a simple and portable Moodle module. It can be used independently, only to check the attendance, or combined with other attendance-required activities to eliminate escapers who would try to enter from the backdoor after the class.

5.3.3 Polling and Quiz Modules

In order to expand the types of activities used in a class, mobile phone activities for administering quizzes (Yamaguchi University) and polling surveys (Hokusei Gakuen University) were developed in 2005-2006. In the course of testing these modules, we made some cost estimates of a typical web session that contained 3-4 quiz questions. Surprisingly, one teacher estimated the fee for using his provider would be approximately 60 yen per session, compared to about 3 yen per email message sent. In addition, an online poll of students showed that 99% used mobile phone email, while 50% had unlimited mobile phone web service, and up to 80% had some kind of web service, often in a pay-per-packet scheme. This disparity meant a significant barrier for students using the web on their mobile phones. While this figure will certainly drop in the near future, the MFM development efforts made a significant shift. A presentation by Houser and Thorton on their research over the years (2003, 2005) made a convincing case that email-based phone-LMS integration was the most immediately needed new phase of development.

5.4 Mail-based, Push Communication

Email-based communication is often called “push” communication because it is pushed into the email viewer of the user, often triggering a signal of received mail. Thus, a more-intrusive form

of communication can be harnessed as one e-learning tool. In the second phase of MFM (Moodle for Mobiles Project), an email-based, non-interactive system to send study material to students was conceived and called Mail Study Streams. It is primarily a language learning module for streaming words, translations, sentences and words in context to student mobile phones as a companion to a full Moodle course. It is designed for learners and teachers of second languages, but other subject teachers may be interested as well. It is intended for study to prepare or reinforce classroom/website activities and assessments. Mail Study is not assessed, but is a "pushed" mail system that students can subscribe to or that teachers require. The messages go to mobile phone email addresses but can also be copied to a student's main email address for the estimated 1% of Japanese students who do not use mobile phones. A basic assumption is that the proposed systems should contribute to a project-based or theme/content-based language teaching methodology. They are not designed to be complete or comprehensive learning systems. Rather, they are designed as linguistic support for collaborative learning systems. For example, in project-based learning, groups of learners may research and prepare a presentation on a theme such as "Global Warming". As students begin their projects, Mail Study Stream sends a sequence of messages (stream) to the students' mobile phones in very small bits such as single words, translations, phrases, questions — eg: "deforestation", "Japanese-translation-of-deforestation", "deforested lands", "What causes deforestation?" "a. tree planting, b. overgrazing, c. air pollution." These streams can be sent several times a day or several times a week to prepare or reinforce the projects and classroom activities. Initially, it is non-interactive and non-assessed, but interactive portions or interactive integration with the cross-module Question Bank are possible and are being considered. Mail Study uses unicode and the Database Module for its operation, thus requiring Moodle version 1.6 or later.

5.4.1 Components & Terminology

As the Mail Study Module was designed, the design team needed a set of terms to describe the configurations of information and its interactions between various components of the system. Table 3 explains the terminology for the components of information used in this module.

Usually a Mail Study Stream accompanies, reinforces or prepares for a Topic/Week/Project/Unit of Learning (UOL) on the main course site. UOL is a general term used in IMS-Learning Design and other international e-learning standards used to denote a section of a course (see Berggren et al, 2005). A topic might span one or more weeks in a Moodle course, but might be longer or shorter. We imagine most Mail Study Streams will be designed for a period of one or two weeks. At three messages per day, a Mail Study Stream thus may be 20-40 messages.

Table 3: Terms used to describe information in the Mail Study Module

Term	Description
Stream	A set of messages sent out to a student (forced or subscribed). Usually the stream fits a single topic or week of learning activities in a Moodle course.
Message	A single email message sent out to a student.
Block	A portion of an email message. Typically, a single field selected from the Unit Database.
Unit	A set of database records on a single theme. For example, some themes we are using for projects are: Hobbies, Kyoto Restaurants, Slavery in America, My Summer Vacation. For sharing in repositories, each unit might have a unique name, such as: [projectname-authorname-date]. A Unit is similar to the IMS term, "Unit of Learning" or "UOL".
Database	A particular module in the Moodle LMS that allows flexible setup of fields
Mail Template	Messages in the stream will have varying formats. Each format is called a "Template" or "Mail Template". A Template is composed of Blocks which automatically pull content from the Unit database. The messages are sent out automatically (in order of entry or randomly) and do not have to be individually composed. Thus, a teacher or student (if given that authoring role) could design a Mail Study Stream quickly, simply by defining a single Mail Template and entering a list of words in the Unit Database.

Therefore, a Mail Study stream may be considered an 'activitiy' because it has a pedagogical goal and/or a single theme. Mail Study includes at least four forms of study: 1) Word, 2) Story, 3) Question, and 4) Collocation, which are described in Table 4. Teachers can choose any forms that are applicable to their needs, or they may create a new form. Each form of study has a different database record with different fields. At first, we would not mix the databases in authoring a single Mail Study Stream, but allow parallel streams simultaneously (a Word stream, a Story stream, a Question stream, a Collocation stream) all during the same week.

Table 4: Types of Streams in the Mail Study Module

Stream Type	Stream Description
Mail Word	focuses on a single word, its translation, and a variety of other dictionary/glossary information about that word's usage. A Mail Word record will be bilingual, not multi-lingual, as sharing of sets of words will be in pairs of languages (e.g.: English-Japanese, French-German, Japanese-Korean). Note that English-Japanese sets would be different from Japanese-English sets.
Mail Story	focuses on a story, or series of related texts. It could also be a series of student postings to a forum or a journal.
Mail Question	focuses on a question, and a limited number of possible answers.
Mail Collocation	focuses on phrases and compound words.

5.4.2 General Design Considerations

* mail delivery (not web) to provide regular exposure to target language
* delivery can be forced (more teacher control) or subscribed (more student control)
* focus on "units" of mail messages on a project-based or content-based topic which would reinforce several weeks of classroom lessons (blended learning approach)
* each unit would include messages sent either in sequence or random
* messages would be non-interactive for study (some could also be interactive as well)
* messages would be either 1) words, 2) stories, 3) questions
* word-focused messages would be like flash cards, for review of vocabulary
* story-focused messages would be like a book, divided into reading segments
* non-interactive questions could work by having a 5-10 blank lines to scroll down to see a correct answer
* collocations need to be considered as well as single words, especially phrases used in context of a particular project

More design notes by the lead programmer are listed on the moodle.org documentation site for Moodle for Mobiles (Pratt, 2008).

5.4.3 Development Strategies

* begin with non-interactive messages and move toward interactive
* begin intensive use in classrooms by end of September, 2008
* for word messages, Moodle's glossary module is too defined and not configurable — we need to use question engine or database module for entering content
* if question engine is base, new question types need to be created for handling multiple field word glossaries, multiple field stories
* sending screen might use parts of Modified Quickmail Block — send to mobile phone email (all/some/none), send to school email (all/some/none) — show student name, photo, subscribed/not subscribed
* unit authoring of email messages: mass upload for quick authoring of short bits — via Excel?
* various templates for sending which could include single or multiple records and/or single or multiple fields
  - template 1: word in target language, 7 blank lines, word in native language
  - template 2: word in context sentence
  - template 3: question, answer1, answer 2, answer 3, 7 blank lines, correct answer

* easy or automatic sequencer/scheduler over 1-2 weeks

5.5 Field Testing in University Institutions

All three mobile phone scripts were applied to university classes. It was tested in several lecture classes in Sapporo Gakuin University and Fuji Women's University over two school years — 2006-2007 and 2007-2008. The development of the Mail Study module was completed in early 2006 and tested in the second semester of that year (September-December) in two institutions — Sapporo Gakuin University and Hokusei Gakuen University. The development of the Lecture Feedback and Attendance Slip modules were initially completed in 2003-2004 as a combined module, and then were separated into two modules in 2006. Data collection for this study was conducted by holding interviews with the four participating teachers, collecting teaching notes and holding online discussions over the course of the two-year period.

6 Case Studies of Mobile Phone Integration into LMS

Three case studies were conducted by a collaborative teaching-researching team in the use of LMS-integrated mobile phone pedagogies. The three cases were selected from classes that the teacher-researchers were currently teaching. Thus, teachers chose a class and set of participants based on their current teaching practices and their students' needs. The first case study involves email-based vocabulary study in a reading class with advanced English (EFL) major students. The second case study focuses on lower level English majors in a content-based communication course with mobile phone email streaming. The third case study examines a cultural history course with in-class attendance-taking and lecture feedback by mobile phones.

6.1 Case Study One: Higher level TOEFL vocabulary study

During the last two weeks of the Fall 2006 semester, students in a 1st year reading course at Hokusei University had the option of receiving mail study streams to their cell phone. After a short description of the course and how the cell phone email system was used, student perceptions of the system and a few general conclusions were provided. All the students who participated were highly motivated English majors and were keen to try new ways to improve their English skills. Students in the English Department of Hokusei University are required to take an institutional version of the TOEFL test (TOEFL-IP) annually. Up until the spring of 2007, the freshman reading course for English majors included a TOEFL component. To supplement our TOEFL reading textbook, at the beginning of the semester, students are given weekly word

lists — each consisting of about ten words that frequently appear on the test. For ten weeks of the semester, students were given a short quiz based on the current word list.

The mail study application was considered ready for student testing during the 12th week of the 13-week Hokusei Fall semester. During the 12th class, students were informed of the mail study option and were told that, if they wanted to, they could receive an email daily at 6pm containing one of the vocabulary words that would be found on the following week's final test. Intended as a form of review of the words, these email messages contained the vocabulary word, the meaning, an example sentence, and a thought provoker. Figure 1 contains an example.

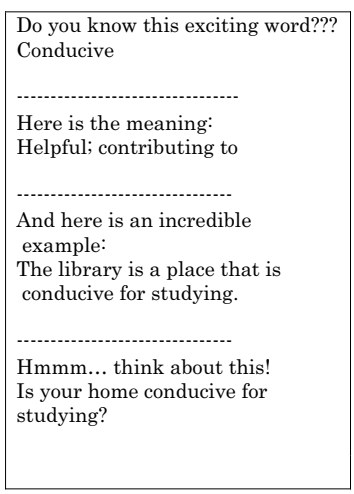

Figure 1: Sample mobile phone screen with content sent to students

Twelve out of the 25 students in the class volunteered to try the mail study system. They were given instructions on how to enroll in the system by emailing the server. At the end of class, some students stayed late and were able to successfully enroll. Others were successfully able to enroll outside of class but two students reported the following week that they were unable to do so. This is most likely because they mistyped the email address or their student number. In total, ten students (9 female and 1 male) received vocabulary review messages via the email study system.

During the following week of class, five students who used the mail study gave their reactions. Generally speaking, the students were positive regarding the content of the messages but unimpressed with the plain text formatting. Several students mentioned that they liked the fact that it created an extra, quick opportunity to study which they probably would not have had on their own. These same students also mentioned that since the content was on the cell phones,

they could review even when they didn't have any texts or notes with them.

When asked if the daily messages were ever disruptive, one student said the email caused her phone to ring when she forgot to turn in on manner mode while she was riding on the train, but other than that, they said a daily message was fine. When asked if and when they read the messages, all students reported that they read at least half of the messages when they arrived. In the case of messages that they didn't read upon arrival, they said that they read less than half of them although sometimes they remembered a previously unopened email when the next email came. Only one student said she read every message when it arrived.

Since this study only took place over one week, the messages were perceived as something new and interesting. If this study had taken place over a longer span, the instructor believes that the rate of reading of the emails would decrease as the newness factor wore off. This is something that should be examined in future studies. Considering that the students in this study were highly motivated English majors who volunteered to receive the emails, it may be expected that the rate of reading of emails would be dramatically lower for unmotivated students who cannot choose whether to receive the email messages or not. Therefore, the instructor thinks that the mail study tool is not a valuable tool for making unmotivated students motivated, but it is a useful tool for helping motivated students review material.

Overall, the response was positive but unfortunately the mail study was done too late to do a comparison of whether receiving vocabulary review messages helped improve students' scores on the vocabulary section of the final test. It would be interesting to examine this further after students have been receiving the messages over a longer span, such as one month or more.

Creating an initial template and setting up the content in the data base is certainly time consuming. However, as the instructor becomes more familiar with the process, mail stream creation will certainly become quicker. Furthermore, if the material can be used with multiple classes, it will also become more efficient and time-effective. Finally, the amount of time spent on creating the mail stream will depend on the number of messages and the amount and complexity of the messages. The time spent on creating mail streams will also vary from teacher to teacher according to their own evaluations of how much it may benefit their classes. Certainly, as the process becomes more familiar, it will also become faster.

6.2 Case Study Two: Middle-level content-based vocabulary study

In the second case study, two teachers applied mobile phone vocabulary learning to a content-based class of Intercultural Communication Theory at Sapporo Gakuin University. One teacher, Sonoyo Ishikawa, introduced the Mail Study program to her class of 30 students, where 15

volunteered to try the program in between April and July, 2006. Because the service costs the students money, the program was voluntary. The students were 3rd year English majors, composed of 7 male and 8 female students.

The instructor chose this particular class because the students were learning both English and intercultural communication. She believed that reading English would help them to increase their exposure to the second language. she intended the program to give extra information beyond the classroom topics and hoped this would increase the students' level of interest. She anticipated that the mobile phone would generate much of this interest. She cited the very high ownership of mobile phones and the fact that students access them far more often than they access computers as reasons. She also recognized students' familiarity and ease with different kinds of media.

When asked why she did not use paper-based exercises, the instructor observed that some students may be absent, some may not read the paper carefully and some may simply put it away and forget about it. On the other hand, she observed that students usually open their emails, especially if they come from their instructors.

The instructor's role in the development team of teachers was to create content for email messages and to learn how to set the mail streams to her students. She set up her mail streams to go out twice a day, avoiding class times and night times when a mail-received alarm might wake the students. The content focused on vocabulary — definitions, translations and explanations.

Her messages were designed with seven parts centered around a multiple choice format:

- Greeting
- Multiple Choice Question
- Answer choices
- Blank lines/scroll down
- Correct Answer
- Explanation
- Closing

The greetings and closings were designed to create a personal and informal atmosphere, as if it were a personal communication from the instructor. After the greeting, a question was given and followed by 3-4 possible answers. After viewing the answer choices, blank lines were inserted to temporarily hide the answer from the student. These blank lines until the answer were intended to force students to think of the answer first, before seeing the answer. This was a

simpler substitute for a true online quiz, which would require using internet to contact a main server for the correct answer, and subsequently waiting for the server to send a reply such as correct or incorrect.

The emails covered and reviewed the important points of the class with the aim of helping students to remember what they had studied. It was hoped that this would motivate more competitive students. Goal-driven students may see this as a way of raising their confidence to get a higher score. They may also see it as a game, deriving instant satisfaction from solving puzzles. Students who are less confident in English or those who do not enjoy quizzes are likely to derive less satisfaction from such activities. Stories were not used, so those students who like stories were not engaged. Thus, learners may be more or less engaged due to variances in their learning styles. It was also considered that this style of learning may appeal more to individualistic learners rather than collaborative learners.

The instructor noted that initially there were delays in sending out the mail streams at first due to difficulties in understanding how to send them. Students, too, were initially confused because they did not at first identify the sender of the mail streams with their instructor. However, they soon became accustomed to this and the students were able to receive the messages in a timely manner.

One student complained that there were too many messages. Another student suggested that the topics were not very interesting and that low levels of interest may mean that students would not open all their messages. This would be especially true if the format were always the same. Finally, one student complained because the messages were all in English.

In terms of future potential, the instructor noted that a more varied and entertaining range of formats might be more attractive to students. This would include such things as images, illustrations and animation. It is also important to include more collaborative activities such as surveys or social activities. Rather than merely a text-based, vocabulary-focused program, material that is more vivid, visual and interactive would generate more interest. In addition, if the messages could be more personalized, students would probably pay more attention. Finally, she observed that the technology could have valuable application for contacting students who are absent. In practical terms, setting up the programs is time consuming; if she had had been given more time, she would certainly have continued to use the mail study program in 2007.

6.3 Case Study Three: Attendance control and lecture feedback collection in cultural history courses

The third case study was undertaken in cultural history courses in two schools, Sapporo

Gakuin University and Fuji Women's College. In each week's class, students were told to enter their attendance slips (pre-printed and distributed manually by the teacher) and summarize or criticize the lecture via the Lecture Feedback Module after the class. Students were able to access the modules not only with computers outside the classrooms but also with their own mobile phones during the class-time. Therefore, in practical terms, students could use two interfaces which can be separated into the three categories:

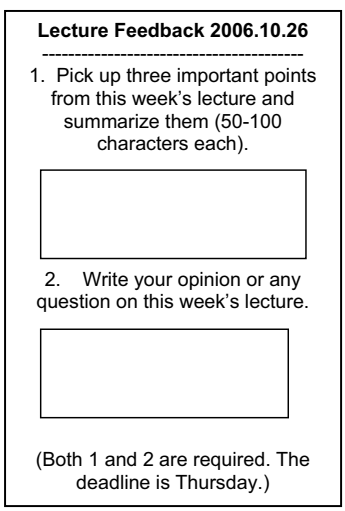

Figure 2: Sample mobile phone screen of the lecture feedback module (mobile version, originally in Japanese)

1. Access with both computers and mobile phones

Most students immediately became accustomed to the mobile interface and started to enter their attendance codes just after they received the slips. Lecture feedbacks were, on the other hand, less edited via mobile interface probably since the activities were assigned as homework. Some students wisely made brief memoranda in the classrooms and then elaborated on them later on the keyboards of their school or home computers.

2. Access only with computers

Some students did not use their own mobile phones but accessed the Moodle LMS only with computers. Although we have not directly investigated the reason for this in the present research, it would be reasonable to suppose they attempted to economize on their mobile phone fees. This point still remains as a problem even though the new two modules are designed to reduce the connection fees for students.

3. Access only with mobile phones

Especially in Fuji Women's College where no appropriate computer rooms were available for the instruction at the beginning of the semesters, most students used only mobile phones to submit both the attendance codes and the lecture feedbacks. There were no direct complaints concerning the connection fees from students even though the problem, needless to say, existed.

7 Discussion

This paper has demonstrated benefits and limitations of integrating of mobile phone technology into learning management systems and blended learning environments. As has been indicated, there are several points to be considered. These relate to:

- the technological challenges faced in providing material to students in a timely, coherent and affordable manner.
- the pedagogical limits of the system; its potential for teaching a range of skills, structures, grammar and functions. The degree to which the technology is compatible with the principles of collaborative learning in the context of content-based curricula must also be analyzed.
- the potential for using the system for more efficient classroom administration. An effective system of attendance-taking can save time for the teacher and administrative staff, while a feedback component will provide teachers with insights into the effectiveness of their classes while, at the same time, allowing teachers to monitor the degree of involvement and understanding of students.

The technological aspects outlined above indicate that, some serious problems notwithstanding, the system has enormous potential. Many of the limitations to mobile phone learning that Wang & Higgins (2006) outlined were confirmed. First, small screen size and distorted web pages proved to be a significant problem, so a parallel scripting development strategy was adopted. The screens on the mobile phone were customized only for the phone rather than compacted from the larger standard screens. The second limitation, input limitations, was less of a factor as student input speeds were rather high in the Lecture Feedback case, and not a factor in the Mail Study case where students did not have to input anything. The fourth technical limitation, lack of standardization and compatibility, was a major factor as the programmers were forced to create screen designs using only plain text (no color, no HTML styles, no anima-

tion) as the lowest common denominator, in order to be able to be used on the greatest variety of phones. An initial plan for an animated Flash-based interface was abandoned due to the incompatibility of many legacy mobile phones in use by students today. The final technical issue that Wang & Higgins referred to, small memory and storage, was not a factor because almost no data was being stored on the phones themselves. The data was held in a central LMS server and delivered as needed via PHP scripting. This is an advantage of LMS-integrated mobile phone applications, which do not require memory-intensive, mobile phone-resident applications.

Similarly, many of the pedagogical limitations of the Wang & Higgins (2006) analysis were supported. The first limitation, difficulty to follow up learning achievements, was particularly significant. The interaction and storage of data on a central database for each class is important for the ongoing community aspect of language learning. It is not just a database for storage quiz scores or other assessments for the convenience of the teacher, but also for the reuse of student-generated data. The re-reading and summarizing of this data is an integral part of a social constructivist learning philosophy. In addition, web-based activities that are connected to the community database will have the ability to be tracked, not only by the teacher, but also by students seeking to watch their own participation and learning achievements inside and outside the community.

A second pedagogical limitation, the difficulty of testing when students cannot be authenticated or supervised in testing situations, was not a concern in this study. Testing was not the aim of any of the activities in these cases. Both the Mail Study and Lecture Feedback activities were intended as supplementary or reinforcing activities to the learning process rather than summative assessment instruments. However, the Lecture Feedback tool does show that an open-ended question that requires creative, summarizing cognitive skills may have some role in testing, since the originality of the response is most valued, rather than the congruence with a teacher-presented “correct” answer.

A third pedagogical limitation, lack of classroom atmosphere, was definitely a concern in these case studies. All cases involved blended learning, whereby the teachers and students engaged in direct face-to-face learning activities, with mobile phones providing an adjunct role in the learning process.

A final pedagogical limitation, environmental interruptions, was not a factor because the mobile phone exercises were designed for between 5-20 minutes of activity. This amount of time would likely not be affected by outside environmental interference. Similarly, the cases in this study did not consider psychological limitations — slow change of habits and health risks — as important factors in this study, again due to the small amount of time required to engage in the

activities.

More specifically, in foreign language learning the pedagogical considerations are challenging. At the moment, it seems clear that one of the main applications relates to vocabulary re-enforcement. As has been shown, this is clearly useful for practice in areas such as TOEFL, TOEIC and other similar testing formats. Especially, the fact that vocabulary may come to students' phones in a random order (with the same word possibly being repeated several times) is a useful mnemonic device, as is the fact that the word is given in a context that illustrates its meaning and use. This is fine for examinations but, in terms of promoting fluency or linguistic dexterity, it must be seen as an exercise of limited usefulness. The reason for this is that this type of exercise is of the 'receptive/responsive' type which means that, at worst, it is a passive exercise and therefore very undemanding of students' intellectual commitment and, at best, it is minimally demanding, asking that students merely select a correct definition key. This, in turn, introduces a degree of randomness into the process as well as the possibility that deduction has been substituted for real comprehension. It must be stressed, however, that this kind of exercise is undoubtedly of some benefit, especially for highly motivated students and especially when the language is related to what is being taught in the classroom. However, it must also be recognized that its usefulness should not be overrated.

Cloze exercises are another common application, with students being invited to put correct parts of speech into appropriate spaces. These have all the benefits of an ordinary classroom cloze exercise except that students with the phones will probably be working alone. They will not have the benefits of peer moderation nor the communicative aspects of question and answer sessions that classwork cloze exercises can provide. As such, they also become 'receptive/responsive exercises with the same pedagogical limitations. Often, cloze exercises follow grammatical precepts, testing knowledge of such items as past-tense forms, adjectives, adverbs or prepositions. This certainly helps with the 'consciousness raising' aspects of language learning but it is a movement away from the 'meaning-centred' forms of language learning that are currently considered more effective. This may be remedied by providing semantic cloze work but this raises another problem insofar as such exercises tend to be open-ended. This, in turn, introduces more technical challenges to provide systems that can recognize and accept optional answers. Of course, this is not an insuperable difficulty but it is certainly more complex and work intensive. As with the above-mentioned vocabulary re-enforcement exercises, cloze exercises are certainly useful, but their limitations when applied to mobile phones must also be recognized.

The two examples cited above highlight a fundamental challenge facing curriculum design and

mobile phones. Modern pedagogical principles increasingly favor exercises that are communicative, collaborative and task-based. This means that, in addition to the 'receptive/responsive' type of work that we have discussed, it also behooves teachers to introduce work that is more creative. Two such formats were mentioned in the second case study: surveys and social activities. How might these work? That question was not addressed in this study.

For the time being, it is important to recognize the limitations of mobile phone technology and to design courses within the frameworks of those limitations. At the moment, these courses tend towards text-based vocabulary reinforcement and receptive/reactive exercises. As such, they can be seen as a valuable adjunct to a much larger overall curricular design, though perhaps only a small part thereof. At the same time, it is important to recognize the huge potential that mobile telephones have in the future of language learning and, as the technological horizons expand, pedagogical strategies can be developed to match them.

In future mobile phone applications, surveys may be done in the context of task-based work. Students, for example, may be sent to a supermarket to find out where their food comes from. They can record what they find, possibly using such forms as, "I found..." and, "It was produced in...". They may also photograph what they find and describe it in English. They could also take a movie and narrate it in English. All of this information would be transmitted to a class forum via their mobile phones and shared with their classmates. This could be done in text form, as pictures or as a narrative. To make such an exercise more collaborative, students could work in groups, putting their results onto one mobile phone. Another feature of this work is that it encourages more autonomous learning strategies; students are not tied to the classroom.

A common feature of surveys and social activities is that they both involve the sending and receiving of information. A feature of modern telephone technology is that increasingly it is spreading across national boundaries. Harnessing this technology in order to share learning experiences across national boundaries, too, opens limitless opportunities for international collaboration and learning. This may occur within a formal classroom setting with students being set specific language tasks and goals, or it may take place outside the classroom in more informal settings. If students can be induced to send text messages half way around the world as readily as they send messages to their friends in the next town, then the rewards in terms of communicative proficiency will be great.

The third case study demonstrates how the use of mobile phones to take attendance can accomplish multiple pedagogical and administrative purposes at the same time. A mobile phone activity can not only to check who is in class, thereby saving instructors a lot of valuable educational time, but also can give the students an important opportunity to provide feedback on the lesson

contents. Regular feedback from students is a precious commodity for any teacher. But it is also important for students too, insofar as it involves them in their own learning process and helps them to reflect on what they are studying. Providing regular feedback also empowers them and adds a collaborative aspect to their education. At the same time, the teacher is able to gauge how well students have understood their classes and may use the feedback to adapt the methods and content of his or her class.

While acknowledging the challenges to be faced, it is also important to look beyond them and to realize the full extent to which mobile phones may be used in education. The ubiquity of mobile phones and the students' adeptness in using them make them a rich potential resource for the teacher. Indeed, future possible applications may only be limited by our imaginations as teachers. The construction of a 'resource bank' accessible by students and teachers alike, according to needs, will further serve to enhance the systems in two respects; a pooling of ideas for classroom application and a vast bank of activities for students. Problems of costs and compatibility are pressing but not insurmountable.

A final observation must address some very fundamental questions about the effects of mobile phones on Japanese society. Specifically, do they promote or inhibit communication? While initially the mobile phone was simply a one-to-one communication device, the rapid addition of additional functions — text messaging, internet browsing, photo/video taking, and other applications — suggest that the use of mobile telephones may become less and less of a social instrument, and more of solitary entertainment. The burgeoning growth of telephone/televisions and telephone games is likely to make it more so. If, however, social collaboration is increasing, then it is necessary to know more specifically about what kind of communication is going on. Who are students communicating with? What kind of information are they communicating? The answers to these questions lie beyond the immediate remit of this paper, but knowing the answers would facilitate the design of more effective mobile telephone language learning programs.

8 Conclusion

This study demonstrates that LMS-integrated mobile phone applications are both possible and necessary in the exploitation of this new technology. Standalone mobile applications or push-only communications may have a role in e-learning or blended learning, but only a minor one compared with activities that interact with a community database. In two cases outlined above, email-based push communications (Mail Study) resulted in limited enthusiasm and was abandoned after a two month trial. Mitigating factors such as an unavailable programmer and poor screen

designs also contributed to the lack of teacher/student desire to continue the program. However, in a case with web-based, push communication (Lecture Feedback and Attendence Slip), the application has been constantly upgraded over four years and successfully ported to mobile phones as a parallel input method. The innovation has slowly but steadily grown in its establishment within one teacher's standard operation of classes. Furthermore, interest from outside institutions, seeking to adopt this free, open-source application along with a web-based mobile phone Quiz module, indicates that web-based pull activities for mobile phones may be the most appropriate strategy for development in the future. In addition to this recommended direction for development, significant limitations will continue to impede the use of mobile phone technology. In particular, the plan to employ a rich, interactive, Flash-animated environment was found impossible when attempting to create a program that spanned hundreds of different mobile phone models, years, and providers. Finding a common denominator for screen design will continue to plague mobile learning developers for a number of years still to come.

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携帯電話を端末とするオンライン双方向教育システムの開発と効果測定

ヒンクルマン・ダン，奥田　統己，ジョンソン・アンドリュー，
石川　園代，グロース・ティモーシ

本研究の目的は，授業の効果を高めるための携帯電話の活用法の探求であった。そのために，次の３種類のプログラムを開発した。１学生が特定のテーマに関心を持つようにするための電子メールクイズ，２学生からの「質問紙」の携帯電話によるフィードバック，３講義運営をスムーズに行うための携帯電話による出席スリップ。第１の成果は，電子メールによる英単語学習システムとして，３名の教員が試験的に運用した。「英単語：定義：訳語」という構造のデータベースから，教員が作成したひな形に従って単語を抽出するPHP スクリプトが作成された。試作プログラムはうまく動作し，問題はごく一部の旧型の携帯電話だけで発生した。しかし，準備に要する時間の長さ，そして学生からの直接の反応の少なさが，大きな問題として残った。クイズと電子メール学習のデータベースが統合されない限り，教員がこのシステムによる授業の準備のために時間を割くことは見込まれない。第２・第３の成果にも進展が見られた。以前の研究プロジェクトで，われわれは学生が「質問紙」を提出できるｅラーニングモジュールを開発していたが，それは講義終了後に学生がコンピューター実習室に移動して入力・提出する必要のあるものだった。今回のプロジェクトでは携帯電話による入力・提出システムを開発し，学生が講義の教室で出席登録と課題の提出を行えるようにした。この結果，教員学生双方にとって課題の提出・管理に要する時間が軽減された。携帯電話の機種のために本システムに接続できない学生はわずかな割合だった。この点の改善とユーザーインターフェースの改良のためには，学生へのアンケート調査などを含む今後のさらなる研究が必要である。本研究によって，携帯電話がｅラーニングシステムにおいてまた授業運営一般において重要な役割を果たしうることが，具体的に見通せるようになった。

キーワード：ｅラーニング，携帯電話，オープンソース，CALL，外国語教育，学習支援システム，Moodle

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